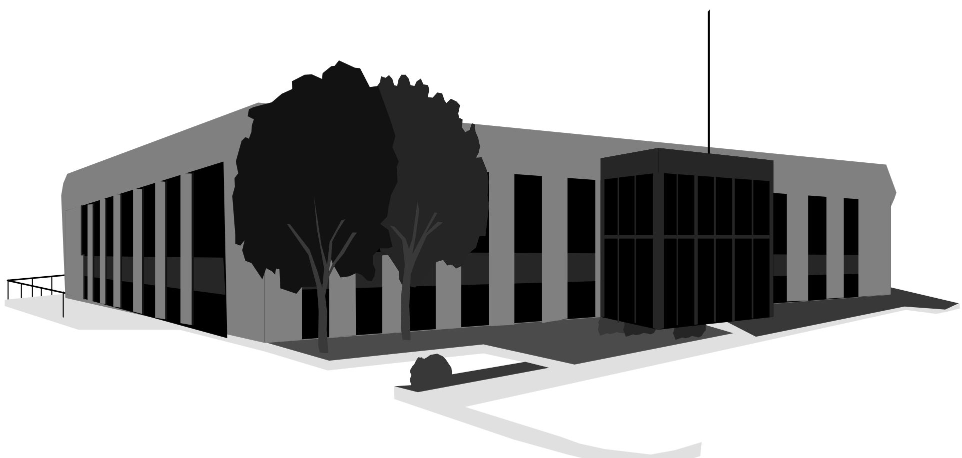
INDOOR AIR QUALITY ASSESSMENT

Butler Middle School
1140 Gorham Street
Lowell, Massachusetts



Prepared by:
Massachusetts Department of Public Health
Bureau of Environmental Health Assessment

August, 2000

Background/Introduction

At the request of the Lowell Board of Health, the Massachusetts Department of Public Health (MDPH), Bureau of Environmental Health Assessment (BEHA) was asked to provide assistance and consultation regarding indoor air quality and health concerns at the Butler Middle School in Lowell, Massachusetts.

On May 2, 2000 Cory Holmes, Environmental Analyst of the Emergency Response/Indoor Air Quality (ER/IAQ) Program and Suzan Donahue, Research Assistant, ER/IAQ conducted an indoor air quality assessment.

The school is a two-story brick building built in 1991-92. The second floor consists of general classrooms, art rooms, science rooms, computer rooms and home economics room. The first floor contains general classrooms, media center, offices, auditorium, music/band rooms, tech. ed./wood shop, gymnasium and cafeteria.

Methods

Air tests for carbon dioxide were taken with the Telaire, Carbon Dioxide Monitor and tests for temperature and relative humidity were taken with a Mannix, TH Pen PTH 8708 Thermo-Hygrometer. Water content in random building materials was measured with a Delmhorst, BD-2000 Model, Moisture Detector with a Delmhorst Standard Probe.

Results

The school houses grades five through eight with a student population of approximately 650 and a staff of 80. The tests were taken under normal operating conditions. Test results appear in Tables 1-6.

Discussion

Ventilation

It can be seen from the tables that the carbon dioxide levels were elevated above 800 parts per million (ppm) in twelve of forty-five areas surveyed indicating a ventilation problem in these areas of the school. It should be noted that many rooms had open windows/doors during the assessment, which can greatly contribute to reduced carbon dioxide levels. Rooms 218 and 110 measured above 800 ppm with open windows, indicating little air exchange in these rooms.

Fresh air in perimeter classrooms is supplied by a unit ventilator (univent) system (see Picture 1). Univents draw air from outdoors through a fresh air intake located on the exterior walls of the building and return air through an air intake located at the base of each unit. Univents at the Butler School are capable of providing both heating and cooling. The mixture of fresh and return air is drawn through a filter and a heating/cooling coil, and is then provided to classrooms from the univent by motorized fans through fresh air diffusers located at the top of the unit (see Figure 1). All univents in the school were functional, and with the exception of rooms 218 and 237, were operating at the time of the assessment. Obstructions to airflow, such as books, papers and posters on top of univents, and bookcases, tables and desks in front of univent returns, were seen in a number of classrooms. To function as designed, univents and univent returns must remain free of obstructions. Importantly, these units must be activated and allowed to operate during school hours.

A mechanical exhaust ventilation system exists in rooms with univents, consisting of wall/ceiling mounted exhaust vents. Exhaust vents were not functioning in a number of classrooms, which can indicate that exhaust ventilation was turned off, or that rooftop motors were not functioning. In addition, exhaust ventilation for the cafeteria and computer room was deactivated during the assessment.

Ventilation for interior classrooms and common areas is provided by three heating, ventilation and air conditioning (HVAC) units located on the roof, second floor mechanical room and the auditorium. Fresh air is distributed via ductwork connected to ceiling-mounted air diffusers. The amount of fresh air drawn into the units is controlled by moveable louvers connected to an activator motor that adjusts to alter fresh air intake to maintain temperature. The louvers were open, indicating fresh air coming into the building. Return vents draw air back to the units through a combination of wall and ceiling-mounted grilles via ductwork. School staff reported that this system was not functioning at its design capacity due to mechanical problems. Control of temperature and humidity is difficult without the system operating at its designed capacity, which can result in comfort and moisture issues (see Moisture/Microbial Concerns).

In some classrooms, the exhaust vent is located above the classroom door. The location of these exhaust vents can limit exhaust efficiency when the classroom door is open (see Picture 2). When a classroom door is open, exhaust vents will tend to draw air from both the hallway and the classroom. The open hallway door reduces the effectiveness of the exhaust vent to remove common environmental pollutants from classrooms. Without removal by the exhaust vents, these normally occurring environmental pollutants can build up and lead to indoor air quality and comfort complaints.

Complaints of stuffiness were reported by occupants in art room 201. The exhaust system in this area was not functioning at the time of the assessment. BEHA staff removed tiles to observe conditions in the ceiling plenum. It appears that the exhaust vent was sealed or was not connected to the ductwork (see Picture 3). Without an active exhaust system, pollutants (e.g. dusts, excess heat/moisture, etc.) can build up in the room.

To maximize air exchange, the BEHA recommends that both supply and exhaust ventilation operate continuously during periods of school occupancy. In order to have proper ventilation with a univent and exhaust system, the systems must be balanced to provide an adequate amount of fresh air to the interior of a room while removing stale air from the room. The date of the last balancing of these systems was not available at the time of the assessment.

The Massachusetts Building Code requires a minimum ventilation rate of 15 cubic feet per minute (cfm) per occupant of fresh outside air or have openable windows in each room (SBBRS, 1997; BOCA, 1993). The ventilation must be on at all times that the room is occupied. Providing adequate fresh air ventilation with open windows and maintaining the temperature in the comfort range during the cold weather season is impractical. Mechanical ventilation is usually required to provide adequate fresh air ventilation.

Carbon dioxide is not a problem in and of itself. It is used as an indicator of the adequacy of the fresh air ventilation. As carbon dioxide levels rise, it indicates that the ventilating system is malfunctioning or the design occupancy of the room is being exceeded. When this happens a buildup of common indoor air pollutants can occur, leading to discomfort or health complaints. The Occupational Safety and Health Administration (OSHA) standard for carbon dioxide is 5,000 parts per million parts of air (ppm). Workers may be exposed to this level for 40 hours/week based on a time-weighted average (OSHA, 1997).

The Department of Public Health uses a guideline of 800 ppm for publicly occupied buildings. A guideline of 600 ppm or less is preferred in schools due to the fact that the majority of occupants are young and considered to be a more sensitive population in the evaluation of environmental health status. Inadequate ventilation and/or elevated temperatures are major causes of complaints such as respiratory, eye, nose and throat irritation, lethargy and headaches.

Temperature readings ranged from 72° F to 77 ° F, which were within the BEHA recommended range in all areas. The BEHA recommends that indoor air temperatures be maintained in a range of 70 ° F to 78 ° F in order to provide for the comfort of building occupants. Although temperatures were within BEHA guidelines on the day of the assessment, a number of temperature control complaints were expressed to BEHA staff. This may indicate that fresh air dampers need adjustment or thermostats are malfunctioning and may need repair/replacement. In addition, it is difficult to control temperature and maintain comfort without HVAC equipment functioning to its full capacity. In many cases concerning indoor air quality, fluctuations of temperature in occupied spaces are typically experienced, even in a building with an adequate fresh air supply.

The relative humidity in the building was below the BEHA recommended comfort range in many areas sampled. Relative humidity measurements ranged from 20 to 45 percent. The BEHA recommends that indoor air relative humidity is comfortable in a range of 40 to 60 percent. Relative humidity levels in the building would be expected to drop during winter months due to heating. The sensation of dryness and irritation is common in a low relative humidity environment. Low relative humidity is a very common problem during the heating season in the northeast part of the United States.

During periods of high relative humidity (late spring/summer months), windows and exterior doors should be closed to keep moisture out when the air conditioning system is activated. In addition, all HVAC equipment (i.e., HVAC units and univents) should be activated to dilute and/or remove moist air in the building. The combination of poorly operating ventilation systems and open exterior doors and windows can cause relative humidity levels to become elevated indoors. While temperature is mainly a comfort issue, relative humidity in excess of 70% can provide an environment for mold and fungal growth (ASHRAE, 1989).

Microbial/Moisture Concerns

Mold growth was reported on pipe insulation above the ceiling tiles in several areas of the school. The insulation had been replaced on the pipes in these areas prior to the 1999-2000 school year. School staff reported that many water-damaged ceiling tiles were replaced during the remediation efforts. First floor classrooms have ceiling tiles that were reportedly water-damaged since the summer remediation (see Picture 4). Uninsulated pipes, supporters and hangers in the ceiling plenum were corroded with rust, which would indicate chronic exposure to moisture (see Picture 5). From these conditions, it is clear that moisture was introduced into the building resulting in condensate on metal fixtures above the ceiling tiles.

Moisture readings were taken on pipe insulation and surrounding materials in several areas. No detectable moisture levels were recorded. It should be noted that the air conditioning system had not been activated for the season, therefore there was no chilled water running through the pipes.

It is also important to note that the second floor of this building appears to be unaffected by the water condensation problem, although this floor is outfitted with univents connected to the air-conditioning system. All of the water pipes that supply chilled water to the univents throughout the building are located above the suspended ceiling in first floor classrooms only. Since no chilled water pipes exist above the suspended ceiling on the second floor, and few if any water-damaged ceiling tiles were noted, it appears that a primary source of moisture resulting in the reported mold colonization is the air-conditioning system.

When warm, moist air passes over a surface that is colder than the air; water condensation can collect on the cold surface. Over time, water droplets can form, which can then drip from a suspended surface. If wetted repeatedly, porous materials (i.e., ceiling tiles, pipe insulation) can grow mold and be a source of unpleasant odors. Water-damaged building materials should be replaced after a water leak is discovered and repaired.

Room 110 had curled/buckled laminated countertops due to moisture penetration. Spaces between the sink countertop and backsplash (see Picture 6) in the home economics room 239 were also noted. Improper drainage or overflow could lead to water penetration of countertop wood, the cabinet interior and behind cabinets. Like other porous materials, if these materials become wet repeatedly it can provide a medium for mold growth, which is difficult to clean and make them irritating to sensitive individuals.

Several classrooms had a number of plants. Moistened plant soil and drip pans can be a source of mold growth. The lack of drip pans can lead to water pooling and mold growth on windowsills. Plants are also a source of pollen. Plants in several classrooms were noted near univent air diffusers (see Picture 1). Plants should be located away from the air stream of ventilation sources to prevent the aerosolization of mold, pollen or particulate matter throughout the classroom.

Room 237 contained an aquarium with standing water (see Picture 7). Standing water can lead to algae/mold/bacterial growth. These growths can be a source of foul odors and can be irritating to some individuals. Regular maintenance and treatment of aquarium water can reduce the opportunity for this equipment being a source of mold/algae growth as well as odors.

Other Concerns

Several other conditions were noted during the assessment, which can affect indoor air quality. Cleaning products and other materials were found on counter-tops and beneath sinks in a number of classrooms. A strong scent of deodorizer was detected upon entry into room 120. The source of the odor was identified as time-released air fresheners plugged into an electrical socket. Air fresheners and cleaning products contain chemicals that can be irritating to the eyes, nose and throat of sensitive individuals. In addition, air fresheners do not remove materials causing odors, but rather mask odors which may be present in the area.

Several classrooms contained dry erase boards and dry erase markers. Materials such as dry erase markers and dry erase board cleaners may contain volatile organic compounds (VOCs), (e.g., methyl isobutyl ketone, n-butyl acetate and butyl-cellusolve) (Sanford, 1999), which can be irritating to the eyes, nose and throat.

The main office and teachers' lounges have photocopiers. Volatile organic compounds (VOCs) and ozone can be produced by photocopiers, particularly if the equipment is older and in frequent use. Ozone is a respiratory irritant (Schmidt Etkin, D., 1992). School personnel should ensure that local exhaust ventilation is activated while equipment is in use to help reduce excess heat and odors in these areas.

Building occupants reported complaints of wood-shop odors in classrooms. These odors may be attributed to the entrainment of wood-shop odors by the ventilation system's return-air vents. No odors were detected on the day of the assessment. Some of the wood cutting/sanding machines are connected to the wood-dust collecting system via ductwork. It was reported to BEHA staff that several of the ducts to the wood dust collection system were disconnected due to excessive clogging by wood dust (see Picture 8). In addition, the wood dust collector contains a filter, which was also clogged with accumulated materials (see Picture 9). Wood duct filters should be changed as per the manufacturer's instructions, or more frequently if needed, to avoid the build up and re-aerosolization of wood dust and particulate matter.

Room 207 contained the science prep room/storage area. Under the sink in this room were three half-pint jars of "Bond 2000". These jars appeared to be of extreme age, as the caps were heavily corroded. The primary ingredient of this adhesive is methyl ethyl ketone, which is extremely flammable. Flammable materials should be stored in a cabinet which meets the criteria set forth by the NFPA (NFPA, 1996).

The home economics room (239) contained a gas stove without a local exhaust hood (see Picture 10). Without local exhaust ventilation, combustion by-products (e.g., carbon monoxide) as well as grease, moisture and cooking odors can buildup in the room.

Accumulated chalk dust was noted in several classrooms. Chalk dust is a fine particulate, which can be easily aerosolized and is an eye and respiratory irritant. Room 237 contained a feather duster. Household dust can be irritating to the eyes, nose and respiratory tract. Feather dusters should be stored in a closet or storeroom. In addition, feather dusters do not remove but tend to re-aerosolize household dust particles.

BEHA staff examined the interior of HVAC unit #3, located in the second floor mechanical room. The filters of HVAC-3 were coated with dirt/dust and accumulated material (see Picture 11). This condition obstructs airflow through the filters, and may serve to reaerosolize and distribute pollutants to occupied areas via the ventilation system.

Pottery items were noted drying on top of the univent in art room 201. Accumulated dirt/dust/pottery debris was also noted within the univent. Clay dust is a fine particulate that can be easily aerosolized and distributed in the air stream from the univent diffuser. Accumulated dirt/dust/debris was also noted in several other classroom univents (see Picture 12).

The exhaust fan located in the ceiling of the elevator was not functioning during the assessment. Exhaust ventilation is necessary to remove excess heat, odors and moisture generated by occupants.

Conclusions/Recommendations

In view of the findings at the time of the inspection, the following recommendations are made:

1. To maximize air exchange, the BEHA recommends that both supply and exhaust ventilation operate continuously during periods of school occupancy independent of classroom thermostat control.
2. Examine each HVAC unit and univent and for proper function. Survey equipment to ascertain if an adequate air supply exists for each area serviced. Consider consulting a heating, ventilation and air conditioning (HVAC) engineer concerning the maintenance and calibration of HVAC equipment and univent fresh air control dampers school-wide.
3. Consider consulting an independent, third-party building engineer for the appropriate methods and materials to control condensation generated by the air-conditioning system and mold growth on pipe insulation.
4. Change filters for air-handling equipment as per the manufacturer's instructions or more frequently if needed.

5. Inspect exhaust motors and belts for proper function, repair and replace as necessary. Close classroom doors to maximize exhaust ventilation. Examine exhaust ventilation in art room (201) to determine function.
6. Remove all blockages from univents to ensure adequate airflow. Clean out interiors of univents.
7. Once both the fresh air supply and the exhaust ventilation are functioning properly, the system should be balanced by an HVAC engineer.
8. For buildings in New England, periods of low relative humidity during the winter are often unavoidable. Therefore, scrupulous cleaning practices should be adopted to minimize common indoor air contaminants whose irritant effects can be enhanced when the relative humidity is low. To control for dusts, a HEPA filter equipped vacuum cleaner in conjunction with wet wiping of all non-porous surfaces is recommended. Drinking water during the day can help ease some symptoms associated with a dry environment (throat and sinus irritations).
9. Repair and/or replace thermostats as necessary to maintain control of comfort.
10. Keep plants away from univents in classrooms. Ensure plants have drip pans, examine drip pans for mold growth and disinfect areas with an appropriate antimicrobial where necessary.
11. Replace any remaining water-stained ceiling tiles, wall board and pipe insulation. Examine the areas above and around these areas for mold growth. Repair water leaks and disinfect areas of water leakage with an appropriate antimicrobial if necessary.
12. Seal areas around sink in classroom 239, to prevent water-damage to the interior of cabinets and adjacent wallboard. Inspect wallboard for water-damage and

mold/mildew growth, repair/replace as necessary. Disinfect areas of microbial growth with an appropriate antimicrobial as needed.

13. Store flammable materials in flameproof cabinets in a manner consistent with state and local fire codes.

14. Install weather-stripping around wood shop hallway door to prevent wood dust penetration into the hallway. Do not conduct wood shop activities with the hallway door open during hours of school occupancy.

15. Restore wood dust collection system to proper function. Clean/replace filter for wood dust collector as recommended by the manufacturer or more frequently if needed.

16. Store cleaning products and chemicals properly and keep out of reach of students.

17. Ensure exhaust ventilation is functioning in areas that contain photocopiers.

18. Refrain from using strong scented materials in classrooms and restrooms.

19. Ensure aquariums are properly cleaned to prevent odors and/or algae growth.

20. Examine the feasibility of providing local exhaust ventilation for gas stoves.

21. Reactivate exhaust ventilation in elevator to remove excess heat, odors and moisture generated by occupants.

References

ASHRAE. 1989. Ventilation for Acceptable Indoor Air Quality. American Society of Heating, Refrigeration and Air Conditioning Engineers. ANSI/ASHRAE 62-1989

BOCA. 1993. The BOCA National Mechanical Code/1993. 8th ed. Building Officials & Code Administrators International, Inc., Country Club Hills, IL.

NFPA. 1996. Flammable and Combustible Liquids Code. 1996 ed. National Fire Prevention Association, Quincy, MA. NFPA 30.

OSHA. 1997. Limits for Air Contaminants. Occupational Safety and Health Administration. Code of Federal Regulations. 29 C.F.R 1910.1000 Table Z-1-A.

Sanford. 1999. Material Safety Data Sheet (MSDS No: 198-17). Expo® Dry Erase Markers Bullet, Chisel, and Ultra Fine Tip. Sanford Corporation. Bellwood, IL.

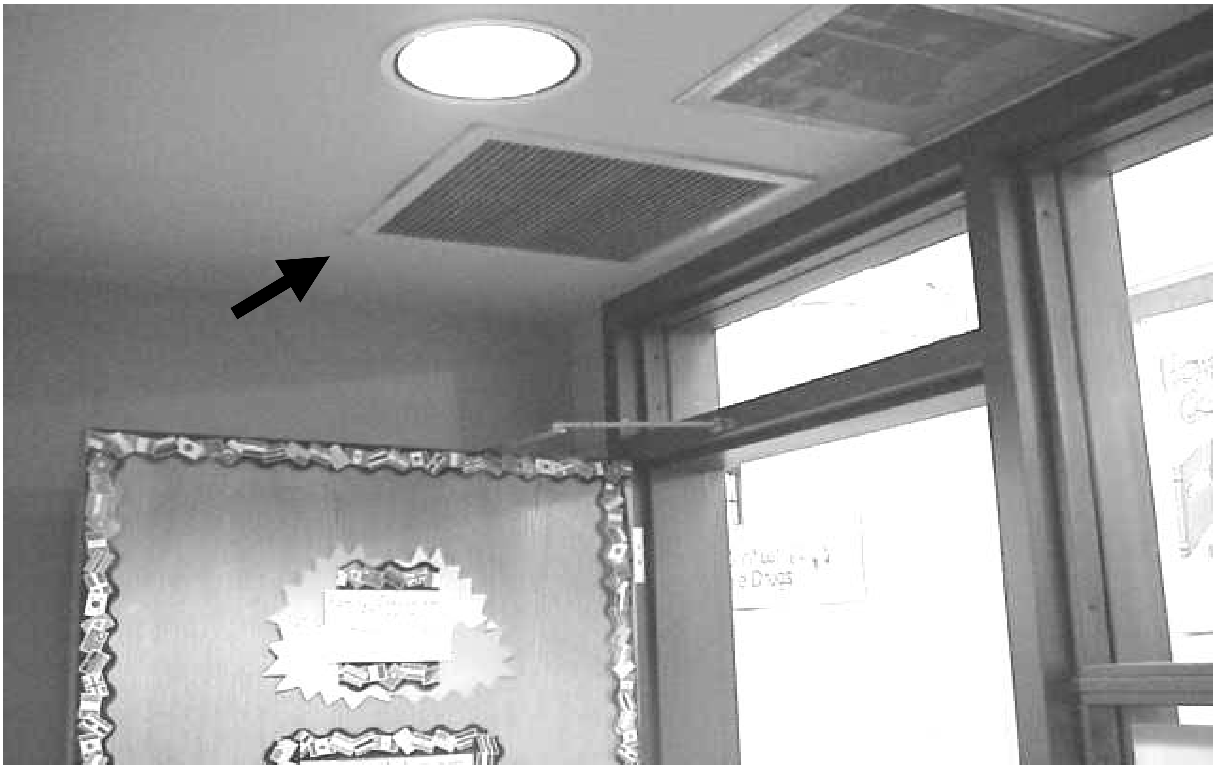
SBBRS. 1997. Mechanical Ventilation. State Board of Building Regulations and Standards. Code of Massachusetts Regulations. 780 CMR 1209.0

Schmidt Etkin, D. 1992. Office Furnishings/Equipment & IAQ Health Impacts, Prevention & Mitigation. Cutter Information Corporation, Indoor Air Quality Update, Arlington, MA.

Picture 1

Classroom Unit Ventilator (Univent): Note Plants on Univent Air Diffuser

Picture 2

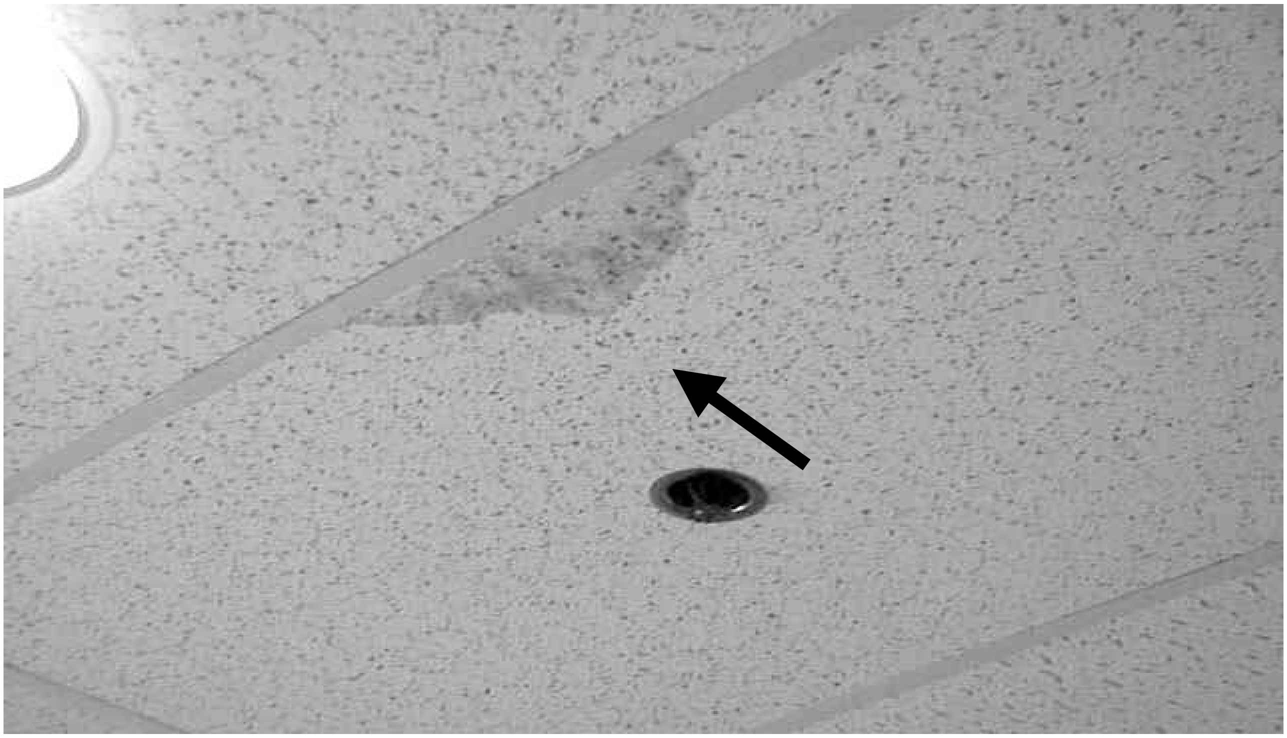


Ceiling-Mounted Exhaust Vent in Classroom: Note Open Classroom Door to Hallway

Picture 3

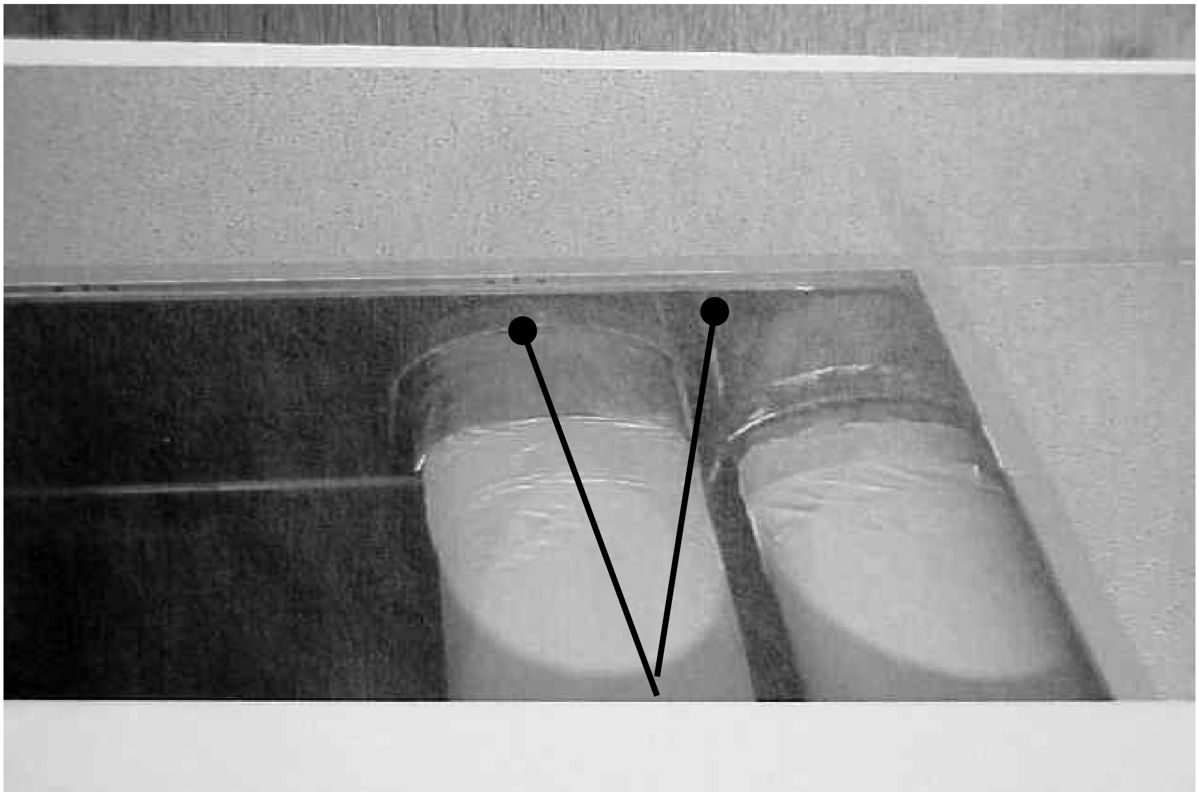
Sealed Exhaust Vent in Art Room

Picture 4



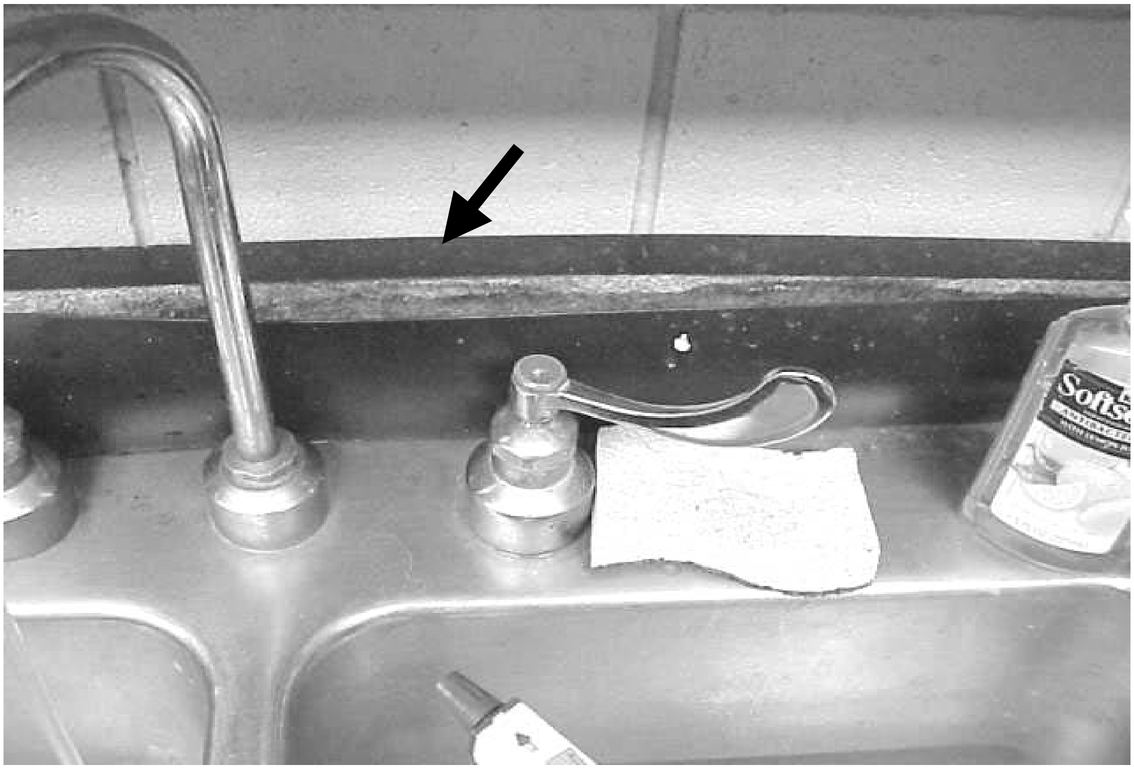
Water-Stained Ceiling Tile in Classroom

Picture 5



Rusted Pipe Hangers above Ceiling Tiles

Picture 6



Water Damage to Sink Backsplash

Picture 7

Aquarium with Standing Water in Classroom 237

Picture 8

Disconnected Ductwork for Wood Dust Collector
(reportedly disconnected due to clogging)

Picture 9

Accumulated Wood Dust in Wood Dust Collector Filter

Picture 10

Unventilated Gas Stove in Home Economics Area

Picture 11

Filter Saturated with dirt/dust accumulation in HVAC Unit # 3

Picture 12

Accumulated Debris in Univent

TABLE 1

Indoor Air Test Results – Butler Middle School, Lowell, MA – May 2, 2000

Remarks	Carbon Dioxide *ppm	Temp. °F	Relative Humidity %	Occupants in Room	Windows Openable	Ventilation		Remarks
						Intake	Exhaust	
Outside (Background)	458	52	75					weather conditions: rain, clouds-am clearing as day progressed
Media Center	730	75	36	~40	no	yes	yes	~15 computers, ceiling fans, carpet, 6 CT
Room 226	614	73	38	8	no	yes	yes	chalk board, 1 CT
Room 218	925	76	37	19	yes	yes	yes	univent off, window open, chalk dust, dry erase board, 7 computers
Room 216	871	76	37	8	no	yes	yes	chalk board, dry erase board, 4 computers
Room 212	834	73	39	19	yes	yes	yes	1 CT, dry erase board, 7 computers
Room 208	761	75	38	16	yes	yes	yes	~25 computers, chalk board
Room 206	695	74	37	14	no	yes	yes	9 computers, chalk dust
Room 203	808	76	37	7	yes	yes	yes	chalk dust, items on univent
Room 202 Art Room	764	74	40	14	yes	yes	yes	exhaust off, cleaning products, chalk dust, computers
Room 228	517	74	40	1	no	yes	yes	2 CT, plant, chalk dust, cleaning product, complaints reported-eye

*** ppm = parts per million parts of air**
CT = water-damaged ceiling tiles

Comfort Guidelines

Carbon Dioxide -	< 600 ppm = preferred
	600 - 800 ppm = acceptable
	> 800 ppm = indicative of ventilation problems
Temperature -	70 - 78 °F
Relative Humidity -	40 - 60%

TABLE 2

Indoor Air Test Results – Butler Middle School, Lowell, MA – May 2, 2000

Remarks	Carbon Dioxide *ppm	Temp. °F	Relative Humidity %	Occupants in Room	Windows Openable	Ventilation		Remarks
						Intake	Exhaust	
								irritation
Room 230	963	76	37	43	yes	yes	yes	6 computers, chalk dust
Room 240 Computer Room	459	74	29	1	no	yes	yes	~30 computers, dry erase board-cleaning products on ledge
Room 205 Computer Room	446	74	29	0	no	yes	yes	~24 computers, dry erase board, supply/exhaust vents in close proximity
Room 224	693	75	34	20	yes	yes	yes	chalk dust
Room 142	569	75	30	17	yes	yes	yes	chalk dust, dry erase board, 14 computers
Main Office	524	75	27	3	yes	yes	yes	exhaust off, photocopier, plant
Nurse's Office	573	77	29	2	yes	yes	yes	supply vent off
Room 128	627	72	41	16	yes	yes	yes	chalk dust
Room 120	597	72	41	4	no	yes	yes	supply vent off, chalk dust, "plug-in" air deodorizer

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TABLE 3

Indoor Air Test Results – Butler Middle School, Lowell, MA – May 2, 2000

Remarks	Carbon Dioxide *ppm	Temp. °F	Relative Humidity %	Occupants in Room	Windows Openable	Ventilation		Remarks
						Intake	Exhaust	
Room 116	781	72	45	21	yes	yes	yes	chalk dust
Room 110	878	72	44	23	yes	yes	yes	exhaust- very weak/off, window open, dry erase board, complaints reported-headaches/sinus problems
Cafeteria	721	73	39	~100	yes	yes	yes	3 CT
Room 122	854	73	42	23	yes	yes	yes	chalk dust
Room 124	855	75	37	6	no	yes	yes	supply vent off, chalk dust
Gym	524	75	36	0	no	yes	yes	
Room 138	563	74	35	26	no	yes	yes	3 CT, 16 computers, chalk dust
Room 237	760	77	27	20	yes	yes	yes	univent off-plant debris in univent/flowering plants on univent, feather duster, aquarium-standing water
Room 225	484	76	23	1	no	yes	yes	

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TABLE 4

Indoor Air Test Results – Butler Middle School, Lowell, MA – May 2, 2000

Remarks	Carbon Dioxide *ppm	Temp. °F	Relative Humidity %	Occupants in Room	Windows Openable	Ventilation		Remarks
						Intake	Exhaust	
Room 223	579	73	26	10	yes	yes	yes	
Room 145 Band Room	442	72	20	19	yes	yes	yes	door open
Elevator							yes	fan not operating
Room 127	636	71	35	10	yes	yes	yes	1 CT, door open
Room 121	728	70	39	19	yes	yes	yes	
Room 115	989	74	35	22	yes	yes	yes	exhaust weak, IAQ complaints reported
Room 111 Teacher's Lounge	765	77	30	2	no	yes	yes	photocopier
Room 125	952	75	32	27	yes	yes	yes	2 univents, chalk dust
Room 129	727	75	28	12	no	yes	yes	door open
Room 133	582	76	26	5	no	yes	yes	door open
Room 135	578	73	29	12	yes	yes	yes	

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TABLE 5

Indoor Air Test Results – Butler Middle School, Lowell, MA – May 2, 2000

Remarks	Carbon Dioxide *ppm	Temp. °F	Relative Humidity %	Occupants in Room	Windows Openable	Ventilation		Remarks
						Intake	Exhaust	
Room 229	576	74	28	7	yes	yes	yes	
Mechanical Room								HVAC 3 – louvers open, filters dirty
Wood Shop	632	74	29	15	no	yes	yes	ducts/filters-clogged by wood dust/disconnected, some machinery ducted/some not, reported-return vent entrained woodshop odors, non flammables in flammable storage cabinet
Room 217	820	74	32	20	yes	yes	yes	
Room 213 Teacher's Lounge	643	76	37	3	yes	yes	yes	2 CT, photocopier
Men's Restroom 214							yes	
Room 209	954	76	31	21	yes	yes	yes	
Room 239 Home Ec.	618	74	30	10	no	yes	yes	gas stove-no exhaust hood, spaces-sink/backsplash, water damaged paneling

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TABLE 6

Indoor Air Test Results – Butler Middle School, Lowell, MA – May 2, 2000

Remarks	Carbon Dioxide *ppm	Temp. °F	Relative Humidity %	Occupants in Room	Windows Openable	Ventilation		Remarks
						Intake	Exhaust	
Art Room 201	606	73	29	8	yes	yes	yes	exhaust off, dirt/dust/debris in univent, pottery items drying on univent, 2 CT, reported IAQ complaints (stuffiness) kiln – in small room off 201, dedicated exhaust

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CT = water-damaged ceiling tiles

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